ENGINEERING-EDUCATION

Bulletin of the

Society for the Promotion of Engineering Education

VOL. X LANCASTER, PA., FEBRUARY, 1920 NO. 6

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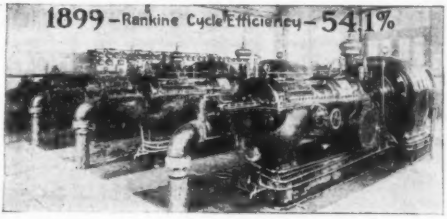

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TABLE OF CONTENTS.

On Motivation. W. K. Hatt 186

Coöperation of the College, U. S. Bureau of Mines, and Industrial Corporations in Research Investigations. E. A. Holbrook 199

What are the Chief Defects in the Product of Engineering Schools? B. F. Groat 207

Editorial 212

Time of Meeting of the S. P. E. E. 213

Coöperation Between Engineering Colleges and Industries. Ernst J. Berg 214

Culture 215

Necrology 215

College Notes 222

ON MOTIVATION.

BY W. K. HATT,

Professor of Civil Engineering, Purdue University.

The writer will endeavor to summarize the recent views upon the subject of motivation, and the methods of teaching that are expected to motivate the student.

Someone at the Baltimore meeting asked the meaning of "motivation." The reply was that motivation is what the student in the class in gunnery had the day before the armistice, and what he did not have the day after. It is the purpose that energizes a senior when given a real job, as in a thesis, different from the unreal and partial exercises or patterns of his routine work. It is what turns a careless youth into a serious, efficient, forward-looking man when he has a wife and family to support.

It is not, however, the purpose of this article to discuss these generalities, but rather the changes in curricula and in methods of teaching, proposed to secure motivation.

The Motivated Teacher.—The teacher himself should be motivated. He should not settle down to a routine job in which he is not interested.

What keeps teachers at their work is less mainly their interest in the routine of teaching and the tools of instruction than the liking for this art. Paul Bourget, in "L'Etape," a novel marked by unusual elevation and nobility of thought, has described a teacher of social science, a man of enthusiasm for things of the mind, and he comments on the function of the educator as follows:

"un vrai professeur tel que celui-là, un de ces accoucheurs d'esprits, possédés par la passion du talent jeune. Les éducateurs de grande race éprouvent, á discerner dans un écolier de dix-sept ans les premiers linéaments de la supériorité future, des émotions d'inventeurs et d'artistes.

Préciser, hâter l'achiévement de cette ébauche, conspirer á l'éclosion de cette noble fleur humaine, s'associer á ce miracle: la formation d'une belle intelligence, telles sont les délices de ces maitres, qui demeurent le plus souvent anonymes."

The writer ventures to translate freely this passage:

". . . a real professor such as this, one of the mid-wives of intelligence, filled with a passion for budding talent. Teachers of high type seek in a scholar of seventeen years the first features of a future superiority, the emotions of inventors and artists. To make these precise, to hasten the completion of this rough sketch, to plan for the opening of this noble human flower, to associate themselves with this miracle, namely, the forming of a beautiful intelligence—these are the delights of those masters who remain most often anonymous."

This quality of inspiration which kindles the divine spark into flame, is the possession of a great teacher. He may be late for his classes, a poor bookkeeper, or drill master, but if he has this quality and a human sympathy, his students will rise and call him blessed.

But the teacher may also be motivated by research either in the field of the physical sciences, or in his own field of teaching. Freedom from prejudice, and willingness to follow the truth, qualities associated with research, are of high educational value and should be part of the equipment of the teacher. A life of unmixed schoolteaching is quite generally deadening.

Motivation of the Student.—The motivation of the student is proposed either by (1) the so-called "direct" method of teaching, which proceeds from principles to application, or by (2) the so-called "situation" method, which uncovers principles by an analysis of several real situations.

The first method uses deductive logic, as in mathematics. The student follows patterns of thought, abstract in nature, that have served well for so many generations. Under this method, the desire to accomplish a difficult task, and the delight in the exercise of mental powers are certainly sufficient motives for many students. A clear statement of the end to be sought, and an explanation of the bearing of the

task upon some future purpose of the student, will serve for others.

Writing on *"The Natural Method of Teaching,"* in the BULLETIN of this society for November, 1916, Mr. Sanford Moss, of the General Electric Company, insists that there must always be a clear statement of the purpose in order to sustain the interest of the student. Mr. Moss cites the books of Euclid, where a complete statement of the result to be reached was given at the beginning of the demonstration, while at the end comes the familiar Q.E.D.

Mr. Moss has given a clear statement of the second or "situation" method, and he goes as far as more recent writers in re-arranging the sequences of studies, in teaching through situations, in approaching the abstract from the concrete. His article seems to have attracted but little attention, but it defines the question at issue.

The center of the ideas, back of the second method, associated with the name of Dr. Mann, is simply this: that abstract principles should be reached and organized through an analysis of real situations, that is to say, through situations to which are attached all of those circumstances, which are considered by an engineer or other person who must reach a decision in the face of these circumstances. A set of principles is uncovered by approaches from several situations. In other words, we go from multiplicity to unity, a much more difficult method, demanding a very skillful teacher in order to insure coördinations on the backward path.

In the bulletin of the society cited above, Dr. Mann summarizes his investigations of engineering schools under the auspices of the Carnegie Foundation. One of his first conclusions was that instruction should not only develop technique and mastery of principles, but also integrity, initiative, resourcefulness, and common sense. He is also struck with the fact that so many young men with pronounced engineering talent are unable to make good in the engineering schools.

He questions the method of presenting the subject matter in schools as determined by the teacher's conception of log-

ical rigor and theoretical unity, and inquires if some study should not be given to the problem of more efficient methods through which students could accomplish their work, just as industrial managers study the methods by which the individual worker can best perform his task.

The success of Professor More, of the University of Washington, in teaching mechanics led Dr. Mann to ask: Why not give real problems first instead of abstractions? It appeared to him that the task required of the student was not too hard, but the preparation was so abstract in character that there was little connection in the student's mind between the preparation and the task. Dr. Mann thought if the job that a man had to do was understood by him, the preparation would have more meaning and would be undertaken in a better spirit. He thought the work should be more concrete.

Mr. Moss, in his article cited above, would cast off the chain by which most colleges bind themselves; as for instance, that a pupil cannot take calculus until he has analytical geometry; mechanics until he has had calculus; and machine design until he has had mechanics. Mr. Moss thinks that the necessity for such succession is purely imaginary. Instead of working out formulas for stresses in beams before the pupil knows what a beam is and the use of the formulas, he would work in machine design with arbitrary formulas and later on, go through the process of derivation. So, therefore he proposes the use of the principles first and the development afterwards.

The subject of motivation became increasingly important during the war. The theory of the American Army was that the soldier should have an intelligent idea of what he is fighting for.

The vocational detachments at the training schools were taught by the job sheet method. A series of jobs or operations of graded difficulty were arranged—as in auto-mechanics, surveying, concrete construction, blacksmithing, etc. For each job a "job sheet" was prepared. The thing to be done was definitely stated and limited. Then followed a series of

development questions to accompany the performance of the job. These were not like examination questions to be answered after the event. Rather, they were an analysis of the job, and accompanied its performance. Each one called for a decision by the student on the basis of the developing circumstances of the job, or by reference to information in a text. The instructor was to do as little lecturing as possible, and not to answer the questions for the student. The soldiers were not to advance through the shop courses in companies, but rather to infiltrate the subject. Each one went as far as he could and was so certified. It will be seen below that this method of teaching, arranged for a rather simple variety of instruction, was followed in its essence at the Engineering School for Army Officers at Camp Humphreys.

A course of lectures in War Aims was arranged to motivate the soldier. Here the teaching of history was from modern times backward—"starting a student where he is," a phrase attributed to Benjamin Franklin.

The work of Professors More and Duckering in teaching mechanics at the University of Washington by the situation method is well known and has been thoroughly described in the BULLETINS of this society. In the course of events these teachers were detailed to the Engineer School at Camp Humphreys, where the young officers graduated from West Point after two years of attendance, were to be taught the engineering courses. There came about an opportunity to try out the situation method on a large scale, not only in mechanics, but in the engineering courses.

In June, 1919, the Engineer School was surveyed by a group of educators. The operations and courses were reported upon in a pamphlet published by the Committee on Education and Special Training of the War Department, entitled "The Engineer School at Camp Humphreys." This report should be read by all those interested. The reporters analyzed the methods of More and Duckering in teaching mechanics, and the process, as far as the student is concerned, appears in the table below.

CHART INDICATING RELATIONSHIP BETWEEN TYPE OF INSTRUCTION AND PRELIMINARY PURPOSE IN COURSE IN MECHANICS OF ENGINEERING SCHOOL, CAMP A. A. HUMPHREYS, VIRGINIA.

THE STUDENT.	SUBJECT MATTER.	
Interest aroused and maintained by contact with Engineering Situations.	MOTIVATION. Project or Problem.	
INDEPENDENT thought and judgment stimulated by analysis of raw problems.	THE SETTING. A concrete engineering situation.	As a whole.
		In part.
EFFECTIVE HABITS of work and study, and	THE ANALYSIS.	Process.
PRACTICAL uses of working tools established.		Working Tools.
ACQUAINTANCE with Fundamental Principles and	PRINCIPLES.	Basic.
KNOWLEDGE of their relations to solution of Problems.		Derived.
COÖRDINATION and Fixation of ideas.	Rules, Formulas, References, Data, Text.	
OUTLOOK.	Deferred Analysis.	
Expectancy concerning future studies.	Advanced Theory and Research.	

The student is taken to a bridge, for instance, and the necessity, use and practice of mechanical analysis based upon this real situation.

The distinctive feature of the engineering courses such as foundations, roads and bridges is, that in each course there is a major problem with related minor problems constituting a framework upon which the student hangs the subject matter of the text. The major problem is a complete structure that the student is to design, or an engineering project that must be reported upon. A complete description of the situation is given and the controlling conditions are to be determined. In his report the student is required to make decisions, and is thrown back to the text for information, theories, or principles, that control the decision. For this purpose the major problem is further analyzed into a number of minor problems that are related to the whole project, and serve to keep the student's interest alive, and to guide him in the necessary

degree in the sequence of the necessary decisions. The development questions are used as in the job sheets for the vocational work. Sketches rather than detailed drawings are made by the student. Each subject is studied intensively for about 6 weeks. Mechanics and mathematics precede these courses.

At Purdue University the writer had modified his methods in certain senior courses in concrete construction along the lines of the Camp Humphrey report with very satisfactory results. The text-book is Hool and Johnson's "Concrete Engineers Handbook." The students are confronted with a concrete retaining wall that has not hardened, and of which the history of the materials and the manufacture are known. A letter from an attorney asks for a report as to the probable cause of failure, and states that the report must be substantiated in court. The materials are tested; the entire field of materials in the text is searched for possible causes, and with a purpose in view; records must be clear and the report plain to a layman; personal responsibility is felt.

Such courses must not be improvised; indeed they require the most careful planning, and close contact with the student.

Another proposal leading to motivation is a series of so-called vestibule courses for freshmen.* The freshmen are to be divided into small groups. Each group accomplishes several engineering projects throughout the year under one instructor. For instance the student is furnished a topographical map of a dam, reservoir site and power house. He reads this map, learns the purpose of the dam, and its appurtenances. He calculates the watershed, the volume of the reservoir, its center of gravity, the power factors, and so on to the delivery of the power. In this way the operations of simple mechanics, mathematics and the conceptions of physics are attached to an interesting situation. They have more meaning to the student and are more firmly grasped. The

* The writer understands that these have been put in operation at Tufts College.

too great abstraction of the freshmen and sophomore year are avoided.

These courses also serve to orient a freshmen who has only a vague idea of the work of an engineer.

There are not wanting those who would break down the barriers between the separate departments of mathematics, physics and mechanics and teach them concurrently as parts of a whole problem.

To determine what method to use and when to use it, we need a direct trial of the relative efficiency of the proposed methods, and the standard methods, made upon different groups of students, whose mental status is known in advance from intelligence tests. One group should consist of men of quick apprehension, such as are now signalized by such tests as that for "engineering aptitude," and another group should consist of men with a slower, but more logical and tenacious mentality. With the raw material classified, the appropriate tools may be selected to fit the material. And the art of the "born" teacher may become the science of his less fortunate colleague. Teaching might become a profession,, and not a stepping stone to business, administration, or marriage.

Discussion.—It appears then that the aims of education and the methods of instruction that have apparently satisfied so may generations are under scrutiny and criticism. To conservative teachers, whose ideas and methods are derived from tradition, some of the recent proposals seem disorganizing. However, they are voiced by an increasing number of responsible educators, and must be seriously examined.

The teacher should take the middle of the road between the over enthusiastic individual, on the one hand, and, on the other, the blind reactionary who allows an organization to become rigid, the life gone out of it, seeking a home in a new body.

Are we to develop a product to which measurements can be applied, a mechanism that functions definitely? Most college teachers will not admit this test; they claim a certain

elevation of mental level, and in proof point to the future progress of their students. There is an element of self-persuasion here, and the results may not be due to the teacher.

Many teachers will deny that a student needs the kind of interest in his studies that comes from a conscious, patent plan of motivation, secured through the concrete, working back from real situations. They believe that this will only lessen the final power of quick comprehension and abstraction of complicated situations in the case of minds of high caliber. Pupils who must be approached by methods variously referred to as "objective," "situation," "job," "by doing," "starting a man where he is," should, in their opinion, be used in vocational schools and not in the university. This is of course an undemocratic view.

It appears to the writer that engineering work needs many varieties of intelligence. In our technical schools we tend to stress too highly the mentality of the designer, and we fail to reach that student who reacts to problems of construction, of management of men—one indeed who so often only reacts (to his own disadvantage) to the realities of class and student activities, things which President Wilson calls the side-shows.

In the endeavor to produce the efficiency that the business world demands of our graduates, our students should not be deprived of the training of the imagination which underlies the ability to plan, to organize, to design. By imagination I understand what Baudelaire describes in his preface to his translation of Poe's stories ("Nouvelles Histoires Extraordinaries"):

"L'imagination est une faculté quasi divine qui percoit tout d'abord, en dehors des méthodes philosophiques, des rapports intimes et secrets des choses, les corréspondancés et les analogies . . . un savant sans imagination apparait plus que comme un faux savant, ou tout moins comme un savant incomplet."

"The imagination is a faculty quasi-divine, which perceives at first, outside philosophic methods, the intimate and secret relations of things,

correspondences and analogies . . . a *savant* without imagination appears only a false *savant*, or at least as an incomplete *savant*."

Nor in the endeavor to start a student "where he is," should he miss the opportunity to re-think the thoughts of the master minds of the past, and to cherish the ideal. If we start our courses in history and philosophy in the confused issues of the present time, would the student be likely to get back as far as Plato's "Republic"?

Finally, will the "discipline" resulting from the drill of the freshmen year, be sacrificed to the interest secured by the "situation" method; and will it be humanly possible to secure the expert teachers, the small sections, demanded by the latter?

Conclusion.—The situation method is a valuable tool for teachers. Its field is yet to be determined. It will retain in the university for further education a variety of engineering intelligence.

RECENT ARTICLES CONNECTED WITH MOTIVATION.

1. "The Engineer School at Camp Humphrey," published by War Department.
2. November, 1916—"Study of Engineering Education," by C. R. Mann. "The Natural Methods of Learning," by Sanford E. Moss.

   May, 1917—"Mechanics of Engineering at University of Washington," by W. E. Duckering.

   December, 1918—"Liberal Element in Engineering Education," by G. F. Swain.

   February 1919—"Effect of the War on Engineering Education," by C. R. Mann. "Training Required for Engineers," by General Black.

   May, 1919—"Colleges and the War," by Professor F. P. McKibben.

   September, 1919—"Reflections of a S. P. E. E. President," by Director Hayford.

   October, 1919—"Problem Method at Engineer School,

Camp Humphreys," by C. C. More and W. L. Duckering.

3. "Comments on Course in Engineering Mechanics at Engineer School," by Lieutenant W. E. Duckering. Published by Engineer School.
4. *Proc. Am. Soc. of C.E.*, Vol. XLX., No. 6, Report of Delegation of American Engineers.

QUOTATIONS.

By Professor Frank P. McKibben ("The Colleges and the War," BULLETIN, May, 1919):

"He expects something new, something better, than he had at high school. But he finds he has almost exactly the same subjects to study—mathematics, English or German, chemistry or physics. His enthusiasm drops x per cent. at the first recitation and another x per cent. at those immediately following as he rushes from building to building in the hope of finding something to satisfy his longing to become an engineer."

By General William Black (Discussion, BULLETIN, February, 1919, p. 226):

"Why teach arithmetic, algebra, trigonometry and all the rest separately, and not use all progressively as the more intricate computations are reached, using for each class of problems the mathematical process best suited for it?"

From the Report of Delegation of American Engineers, *Proceedings, Am. Soc. C. E.*, August, 1919:

"The opinion was also expressed by the French engineers that the teaching of general studies and sciences in the technical schools should be practical and directed to the needs of the engineer. The instruction in mathematics should not be abstract and theoretic, but practical and concrete. The same is true with regard to instruction in languages and other studies. This tendency is the same that is observable in many of the schools of the United States, and they were heartily approved by the American representatives."

Mr. John F. Hayford ("Reflections of a S. P. E. E. Presiment," BULLETIN, September, 1919):

"I believe that an engineer needs intelligence and must use it,—but not simply a particular kind of mechanical mathematical intelligence.

"As motivation is extremely important to our success as educators should we develop a new motivation in the place of the lost military motivation?

"Which should receive the main emphasis, specialization or general education? The answer is, I believe, both, alternately.

"Similarly, there are those who advocate strongly the presentation of theory first,—practice, concrete examples, laboratory work later. And vice versa, there are those who advocate always taking the reverse order, the observation first and the theory later. Are they not both partly wrong and partly right? Does not the man proceed normally and most effectively by alternating the two in rather short periods?"

"The engineer's greatest service is based largely on his ability to see the things that are not obvious, to see the possible advances that are but obscurely indicated, to see in the blueprint and the description that which is a possible future fact worth while."

"The greatest defect in our educational system at present is the lack of vocational training."

Dr. C. R. Mann ("Effect of War on Engineering Education," BULLETIN, December, 1918):

"The War Department's experience with training soldiers shows that first essential of effective teaching is a clear definition of the result desired.

"The conclusion of psychologists agrees with the experience of the war instruction that knowledge is always specific and is developed best by mastery of specific tasks.

Dr. C. R. Mann (Discussion, BULLETIN, February, 1919, p. 214):

"That is, those who thought that the solution of education consisted in putting the real and practical before the theoretical, and others believed the theoretical should go first. I have now reached the conclusion that it does not make any particular difference, provided the boys want to do it. The fundamental point is to get the boys to want to do it. Sometimes it is advantageous to go from the theoretical to the practical application and sometimes from the practical application to the theory, all depending upon the skill of the teacher; in the individual it does not produce the effect if the boys really want to do it."

Professor G. F. Swain ("Liberal Element in Engineering Education," BULLETIN, December, 1918):

"The subject of this paper is mainly motivation, or by doing work with a distinct motive, gained by being able to see what is being done, the need and use and application of it, which is only possible, if my view is correct, if it can be related to experience.

"No effective results will follow unless the student is interested and sees the value, use, and application of what he studies.

"The difficulty is that in the study of these subjects the student may not be able to relate them to his experience, that is, his work is not motivated, and so he achieves small results.

"The main object of the instruction should be to teach the students to think for themselves. The instruction should be concrete and practical, rather than abstract and theoretical, and should be accompanied by practice in the application of the subjects studied."

Rev. Edward Mewburn Walker, Queens College, Oxford (Address, BULLETIN, January, 1919):

"For what we claim there is this, that the student shall be allowed to study that subject which appeals to him; not up to certain points but up to any points he pleases, and he shall study it in such a way as to clear his mind so to give him power of thought, of criticism, of inference; in a word, to give him a better mind, a better instrument than he started with.

"Now, the great gifts the study of the humanities can impart, besides this general gift of thinking, are the gifts of imagination and sympathy.

"For that quality of leadership is needed quite clearly these two gifts of imagination and sympathy."

Dr. John Joly, University of Glasgow (Address, BULLETIN, January, 1919):

"The difference between the student who can rely upon his mathematics and who knows how to state his problem in proper form so as to apply mathematics to it, and the student helplessly going about to get somebody else's brain to help him out of his difficulties is enormous. To my mind, that constitutes the difference between the good engineer and, speaking generally, the second rate engineer; I do not say it is always the case, but in general that is the case.

Shakespeare ("Taming of the Shew," Act I., Sc. I., Line 40):

"In brief, sir, study what you most affect."

Rabelais ("Gargantua," lvii):

"Fais ce que voudras." "Do what you wish."

CLOSER COÖPERATION OF THE COLLEGES, U. S. BUREAU OF MINES, AND INDUSTRIAL CORPORATIONS IN RESEARCH INVESTIGATIONS.*

BY E. A. HOLBROOK,

Superintendent, Pittsburgh Station, Bureau of Mines.

A part of the Organic Act of the Bureau of Mines charges it with the furtherance of safety in the mining industry; making investigations for the prevention of waste, promoting economic development and conservation of the mineral resources, investigating utilization of mineral fuels; and the dissemination of the information obtained. How better can this be carried out than by close coöperation by the bureau with the colleges and the industrial corporations? The college is the proper place for the training of men to carry on the research work, and the Bureau of Mines an official agency for conducting general commercial research, especially in those fundamental problems the solution and application of which is to benefit the whole mining industry; or those problems the solution of which is of so expensive a nature or of such general application that a single corporation cannot, as a financial business concern, afford the time and money necessary. Finally, the research itself must concern and be of benefit to the mining companies and industrial corporations or to the men employed by them. It is through the business world that practical modification and application of ideas and processes which have been developed by the other agencies must be put into application.

A government investigational bureau may adopt one of two

* Presented at National Conference of Schools of Mines of the American Mining Congress, St. Louis, Mo., November 17–22, 1919. Published by permission of Director of Bureau of Mines.

policies in its development. It may pick out a central location, concentrate its staff, buildings, equipment and energies there and become the recognized center for its special line of work, and to which colleges or corporations may come for coöperation, assistance and advice; or, on the other hand, it may establish central administrative headquarters only and distribute its personnel and equipment in separate stations throughout the country. This policy leads to an especially intimate contact with local institutions and problems and keeps it in close touch with the actual industry. The Bureau of Mines is carrying out the second policy.

The first complete coöperative field experiment station was the Salt Lake station, where in 1914 a coöperative agreement was entered into between the University of Utah and the Bureau of Mines by which the bureau should establish a field experiment station at the university and have the use of certain university offices and laboratories and be given light, heat and power, and the assistance and coöperation of the teaching staff of the university. On the other hand the bureau would maintain a staff of engineers and metallurgists there whose work should be the solution of mining and metallurgical problems which might prevent waste in the industries, increase efficiency and conserve human life. The university further agreed to establish fellowships, the holders of which should be paid by the university and who should work under the direction of the bureau engineers and on commercial problems which were receiving the attention of the bureau staff.

While preference has been given local problems, yet problems arising in distant districts, the solution of which might aid in the industry and on which the experimental work would be valuable in the training of the student body and fellows, have received equal attention. Care has been used not to conflict with the professional activities of private consulting engineers and the mere treatment of an ore or mineral substance to determine its adaptability to a known process has been considered secondary to the development of new

processes or the adaptation of processes to conditions hitherto not thought possible. Experiment stations of a similar nature later were established at the University of Arizona, Tucson; University of Washington, Seattle; University of Minnesota, Minneapolis; Colorado School of Mines, Golden; and the Ohio State University at Columbus. Field stations without college affiliations also have been established at Fairbanks, Alaska, and Bartlesville, Okl., where needs arose but whose location did not admit of coöperation with colleges. At the University of Illinois, Urbana, and the University of California, Berkeley, coöperative agreements have been entered into and limited stations established. They do not, however, receive the full station appropriation from the bureau and their staff is confined to such engineers and metallurgists as has been possible to allot from general bureau funds from year to year. The limited coöperation at Urbana, made first in 1911, is jointly with the Engineering Experiment Station of the University of Illinois and the State Geological Survey and was the first coöperation of the bureau with state and college agencies for conducting investigations.

The main field station of the bureau at Pittsburgh, Pa., has recently entered into a new kind of coöperative agreement with the Carnegie Institute of Technology. The Pittsburgh station, especially in coal mining laboratories, gas, fuel and petroleum testing, has built up large working sections of its own for the solution of problems in these various lines which may arise anywhere in the country. At the present time it is coöperating with a number of industrial corporations and commercial agencies in the solution of general problems, the results of which will be accessible to the industry. For example, the fuel-testing section has agreements with several industrial concerns, with the Shipping Board, and with the War Department by which tests are being carried out under the direction of the bureau, the cost of which is being paid either wholly or in part by the other coöperating agency. The American Society of Heating & Ventilating Engineers is conducting at the Pittsburgh station, under coöperative agree-

ment, a study of ventilation and heat transmission problems. The petroleum section is likewise coöperating with that industry and similar work is being carried on in the chemical and metallurgical sections. The bureau, moreover, is constantly testing commercial explosives and apparatus designed for use in the mines with a view to giving them bureau approval for safety. This work includes testing of mine lights, electrical and gasoline underground locomotives and electrical coal-cutting machinery, permissible explosives, oxygen breathing apparatus, and gas masks for industrial purposes. In this way the bureau is in direct and constant contact with the industries and their needs.

It is desired that educational institutions and the industries have access to the station and be able to take every advantage of results being obtained there. For this reason the bureau has been glad to enter into a coöperative agreement with the Carnegie Institute of Technology by which their undergraduate students in mining may visit and inspect the work being done at the Pittsburgh station, and their graduate students and fellows may be assigned work and take part in the tests and researches being conducted by the bureau. Since the problems engaged in are commercial problems, mostly put up by the industry and of direct benefit to them, such an agreement offers an educational institution a chance to bring the men they are training into intimate contact with the developments and future needs of the industry. It is hoped that other institutions may make similar coöperative agreements with the Pittsburgh station.

The bureau further stands ready as part of its program in the dissemination of information, to set aside one or more weeks in each year in which students of mining or in other engineering and scientific departments of colleges may come to the Pittsburgh station and enter into and have explained to them by special demonstrations the researches under way there.

Why are the colleges, the Bureau of Mines and the mining

industries each necessary to the other for the proper development of mining and allied research?

The college wants to furnish graduates trained to be of value to the industry; the industry is eager for ideas, processes and men that are of commercial value. The bureau must be of value to them both.

Both the college and the bureau have one common object in view, the furtherance and upholding and application of science to the mining industry.

In the past a tremendous amount of research work has been conducted by the colleges alone and a host of problems solved in this yay. With the development of the research idea in industrial corporations many problems are arising, the scope of which is so broad and the expense and time necessary so great that the college needs outside help.

The college or university is primarily an institution for the young men's development and education and secondarily, one for research. It therefore recognizes that having a staff on the campus, who can devote their whole time to research means a greater gain to the research work of the institution than would be indicated by the mere amount of money allotted by the bureau there. It is often stated that the modern engineering school is in close touch with the industries and is no longer isolated on purely abstract and theoretical considerations; however, the very nature of the training which should be developed in the school requires that the institution become not too practical and its staff not too taken up with commercial work lest the college lost its ideals and purposes which make it a place of training superior to that of the shop or field. On the other hand teaching is a profession by itself and even in engineering a man who must devote the entire day to teaching has only a limited period each year in which he can hope to come in contact with other men in his profession and with the corporations themselves. Somehow, the bureau places students and faculty in a position in which they feel more closely in contact with the industry. The bureau men, traveling

about in the field for part time and working at the college for part time are enabled to bring the professional point of view close to the college.

Large parts of many college laboratories under ordinary conditions must be idle for many months in the year. This is not a criticism of the laboratory but a necessary overhead expense which the colleges recognize and which they would gladly overcome were more money or a greater number of classes available. A piece of apparatus perfectly adapted for research work may serve a single class for a single day and then lie idle for half a year or a whole year, until new classes take the same work, unless opportunity is developed for research work. It is therefore of tremendous interest and help to students who often see only their instructors engaged in laboratory and test work to be able to see the Bureau of Mines men working as professional engineers on the same class of problems with which they are expected to familiarize themselves.

From the bureau point of view it has been logical to seek location at or near a college or educational institution where college office space and equipment are available, where the faculty are in touch with local needs and situations and where the surroundings are congenial for research and mutual help.

Another point which must not be overlooked is the ideal chance offered in this way for the bureau to get its ideas and results of its research across to the engineering public. Although it is a government institution it is without police or mandatory powers and its effectiveness depends on getting its work across, on the one hand, to the practicing industry and, on the other, to the men who will control and direct industry within the next few years. In engineering, as in medicine, it is the undergraduate who receives the advanced ideas and processes and, although later practical experience may make him more conservative as to introduction and application of new ideas, yet his very association in college with advanced principles and processes gives him that flexibility of mind necessary to apply new ideas, which never leaves him.

His association with the station as an undergraduate or graduate student gives him the "bureau point of view." This coöperation between the bureau and the college for the carrying out of research work is an ideal one; working together they can present to the industry with double strength things which they believe are for its betterment.

Every corporation has its own research problems. A research laboratory of a corporation is engaged primarily in the problems whose solution is of direct benefit to the corporation and the only point of view is the application of the problem to the commercial success of the corporation. While the large corporations a few years ago felt able to handle their own research problems, the writer ventures that today there is not one of the corporation research departments but that will admit there are basic and far reaching problems which should be solved for the benefit of the whole industry and whose solution would be of direct benefit to them in their work. They further admit that they cannot possibly consider taking the corporation money and time to work on these problems, the solutions of which might be of as much or more benefit to their competitors as to themselves. Further, the results of corporation research generally are not available to the public.

The small corporation in every case must look to outside help on its problems. True industrial research is a slow and costly problem not at all adapted to a small commercialized department which must show decided progress each day.

The industries often fear that solution of their problems by the colleges may involve such a departure from the dollars and cents consideration that they will not benefit by them and that on account of the demands of the college teachers for regular work the time taken may be too great a factor. That they have been willing to coöperate with the Bureau of Mines or with the bureau and college jointly has been proven in many cases during the past few years.

Finally, the bureau, on its part, needs both the other agencies. It must have the college to foster and keep alive for it the ideals of research and to furnish the very material help

in men, materials, or ideas, and because it opens to the bureau the most fertile field for the distribution of results and ideas from research. On the other hand the bureau must be of direct service to and at the call of the industry, and the industry must be satisfied that the bureau's help is worth receiving and its ideas practical and worth adopting else it cannot continue to exist. Therefore, the bureau stands ready at all times to coöperate with the industry and with the college in the solution of problems of benefit to the industry.

WHAT ARE THE CHIEF DEFECTS IN THE PRODUCT OF ENGINEERING SCHOOLS?*

BY B. F. GROAT,

Hydraulic Engineer, Aluminum Company of America, Pittsburgh, Pa.

This question must be considered broadly by the teacher, especially when determining his general educational policies and when establishing his courses of study.

The question can be answered in its broadest sense only when we have determined the future conditions under which the engineering graduate must work and the functions which the graduate will have to perform under these conditions. At the same time, we work under the disadvantages of having to arrive at conclusions based upon future conditions in only the light of past experience.

We have passed through a period of great revolutions, the principal one of which is the changed conditions of world society due to the world war. International relations have been disrupted without having been completely reëstablished on a new basis. National economics must be remodeled; the rights and duties of men will have to be redetermined, and reapportioned.

Perhaps the most potent moral force is that which in the past has been called the law of public policy. This law will become more and more potent as time rolls on. We already see unmistakable evidences of the tendency of governments to investigate, interfere with and direct business of a private nature. It is not improbable that we shall see efforts made to determine what is and what is not legitimate business; what

* Read at the first regular meeting of the Pittsburgh Section of the Society for the Promotion of Engineering Education, Wednesday evening, December 3, 1919.

is and what is not proper individual occupation; what is and what is not permissible economic activity.

It is already a fact that private incomes are investigated and taxed and there are already laws in many codes of various nations prohibiting strikes and denominating them conspiracies where they interfere with industries of vital economic importance.

The laws of civilization naturally base themselves on the principle that they are just if best for society as a whole. This is merely the broadest conception of the law of public policy. Such policy and laws establish themselves by virtue of moral forces which are above man, though they express themselves through the agency of man. Why is it that we see congressmen, senators, presidents, kings, queens, voting for prohibition? Do they want it? Did they vote for it from the start? Or is the project so much above them that they are just barely able to see that if they don't vote for it their job is lost. The truth is they have been voting against it all the time, but finally realize their own individual impotency.

The movement to improve our methods of doing things is shown to a certain extent by the movement now on foot to establish a national department of public works; perhaps there may be connected with this movement at some future time the idea of public service at cost.

During the last ten years I have employed a number of college graduates from a number of colleges and universities and while these men have had their faults, I have found it very difficult to lay my finger upon the faults which it would appear are in any special sense those due to the methods applied in their engineering education.

It seems to me that the principal faults which can be traced to their education are divided into two classes: (1) lack of capacity in the sense that a machine has capacity; (2) lack of general education.

Lack of capacity shows itself in measuring the ability to turn out a large output as in:

1. *Making Routine Reports.*—It was frequently observed that engineering students lack a knowledge of clerkship and a knowledge of the methods of securing accuracy. They frequently do not understand how to check a report so that all of the errors will be discovered and eliminated. Any high-grade clerk can do this. They lack a training in many of the duties required of a clerk.

2. *Surveys.*—Very frequently engineering graduates lack capacity of manipulation. It takes too long for them to do very simple things. They lack diplomacy in many cases. Diplomacy is very necessary when making a survey on foreign ground.

3. *Tests.*—Engineering graduates very frequently fail to produce satisfactory test results. The failure of capacity in this respect is very similar to the failure of capacity in clerkship and accuracy.

4. *Estimates.*—In many estimates it is frequently the case that graduates fail to evaluate and correctly weigh the data at hand.

5. *Designing.*—It is very frequently the case that young engineering graduates fail to distinguish the difference between what should be called correct engineering and what should be called individual judgment. This misconception is not confined to young college graduates. It is not safe to substitute the judgment of an individual for the criteria of correct engineering.

Lack of general education does not show itself merely as a lack of refinement and finish. It goes entirely to the root of fundamentals. Clear conception of ideas is an absolute necessity in engineering; I should say more so than in any other branch of activity. Probably nine-tenths of engineering knowledge comes through the study of the definitions and meanings of words. This applies not merely to technical words but to all kinds of words. I should say that the study of a science is largely a matter of arriving at a clear conception of the meanings of the words which have been employed by the teachers and writers in describing that science.

It is true that we seem to think that we have ideas of a science which are peculiarly our own individual ideas; and yet, we must admit that our own individuality in any particular line of activity consists principally in a display of individual energy rather than in an evolution of new modes of thought.

The engineer should study languages. It must be admitted, however, that he cannot take time to go into the details of languages to the same extent that should be required of a person contemplating a literary life. Perhaps one of the greatest fields for the engineering schools to develop is the proper method of instructing the students in the languages. It may not be amiss to suggest that the engineer should have as thorough an education in English as any other class of student, but that he should thereafter absorb the general nature of the other languages by actually reading and translating important technical articles on important subjects with which he is already familiar. Of course there should be a very brief and concentrated study of the simpler elements of contruction of some of the languages, but this should be merely an introduction, on the ground that a certain amount of such preparation is on the side of economy.

The student's ideas will be greatly broadened, and an immense amount of extremely valuable information will be acquired, by reading generally on important subjects such as law, economics, politics and finance. Such courses of reading should be supplemented by a course of lectures by real experts in the various branches.

These methods are bound to lead to general largeness covering all branches of engineering, and, indeed, will make the student at home in almost any society.

The lack of capacity in general education seems to result from a lack of breadth of courses and from too much time expended on small things. The student should be compelled to dig down to the merest detail in his studies at critical times. He should be trained to go to the ultimate degree of refinement in detail, but it is destructive of his mental development to keep him grinding on these details continuously.

Engineering students should not take too much vacation. Two weeks a year with the ordinary holiday vacations should be plenty. However the conditions are today, it is a fact that the most inefficient institutions we have had in the past have been our schools. An engineering school should be in daily operation the year around. It should keep in touch with its output of college graduates.

One of the best means for keeping in touch with the college graduate is to direct him in his early years toward proper lines of occupation and to advise with him as regards the salary he should expect and demand. One of the reasons why ordinary engineers fail to receive the compensation to which they are clearly entitled is because they do not know what their services are worth, nor do they know what they can demand. In most cases they do not even know what their fellow engineers are getting in the way of compensations and the custom has grown up to a large extent whereby each man has to pull for himself.

The question of discipline is extremely important; it is hardly necessary to go into this matter at the present time but it may be remarked that students frequently do not feel a proper sense of responsibility.

Whatever the conditions are today in our engineering colleges I can say that I was firmly convinced of the fact during fifteen years of college life, in which I acted as student in engineering, student in law, instructor in engineering physics, Assistant Professor and Professor, that there is too much formal class room work and too little time for independent thought and action. The tendency of this state of affairs is to rob the student of a certain kind of initiative force that ought to be developed fully.

I am inclined to think that there should be no formal class room work after the Sophomore year; that the student should work four hours each day in practical engineering and devote another four hours to reading and attendance upon high grade engineering lectures.

EDITORIAL.

The 1920 Meeting.—The twenty-seventh annual meeting of the Society will be held at the University of Michigan, June 29 to July 2. This date is necessitated by the fact that a number of institutions this year have late commencements. The Council has decided that the general topic for the meeting will be "Coöperation." President Greene is working on the program. One of the topics which received considerable attention at the Baltimore meeting was the relation between this Society and the technical engineering societies. This discussion at the Michigan meeting will be opened by President Ira N. Hollis, of Worcester Polytechnic Institute, the first president of the Engineering Council, on the topic "Coöperation with the National Engineering Societies." We all recall with pleasure his address on "Administration" at the Baltimore meeting. The question of coöperation between engineering schools and industries will be discussed by a number of men from industries.

The meeting this year should be rich in personal experiences since most institutions have made decided changes in their curricula and methods of teaching.

The new Alumni Hall of the University of Michigan, the recreation center of the university, will form the nucleus for all the social activities of the meeting.

The Engineering School at the University of Michigan has long been noted for certain excellent methods of instruction. The visiting members of the Society will have ample opportunity to study the work in detail. Dean Cooley and the members of the faculty of the School of Engineering, are entering energetically into the plans for the entertainment of the Society.

The Time of the Annual Meeting.—The attention of the members is called to the short note of President Howe appearing in this issue of ENGINEERING EDUCATION. It is suggested

here for discussion and will come before the Society at the Michigan meeting for action.

Salaries of Engineers Engaged in Teaching.—The American Association of Engineers has created a committee to study the question of salaries of engineers engaged in teaching. Professor C. J. Tilden, of Sheffield Scientific School of Yale University, has accepted the chairmanship of this committee. All deans of engineering schools will be made corresponding members. A comprehensive study of the salary problem with recommendations will be made and these recommendations will be backed by the membership of the association.

TIME OF MEETING OF THE S. P. E. E.

For a number of years the meetings of the Society for the Promotion of Engineering Education have been held during the latter part of June or the first of July, after the colleges have closed. This meeting seriously interferes with the vacations of a number of members. As some scientific institutions close before the middle of June, those members of the faculty who expect to attend the Society meeting are obliged to defer their vacations for two or three weeks. As presidents and professors are pretty tired by the end of the college year, it would seem to me advisable to hold the meetings at some other time. Why would it not be better to hold them during the college year and let the time taken for them come out of that period rather than come out of the vacation, which provides a time of rest so badly needed by all connected with engineering colleges? I would like to suggest that this question be seriously considered by the board of directors and if they should deem it wise, that a vote of the membership, or at least that part of the membership which attends the meetings, be obtained.

CHARLES S. HOWE,
President,
Case School of Applied Science.

Feb. 18, 1920.

COOPERATION BETWEEN ENGINEERING COLLEGES AND INDUSTRIES.

BY ERNST J. BERG.

Three methods of coöperation between engineering colleges and industries may be feasible. The first involves short periods of alternating work between the college and the factory. The second, involves periods of longer duration—a month or so—and the third, continuous work at the college, during the college year and properly arranged work during the summer vacation at the factory.

The first alternative has been given a very fair trial by Union College. During the last semester of the senior year the electrical engineering class was divided into two sections which spent alternate weeks at the college and at the General Electric Company's shops.

Not only the college was anxious that the trial should be fair but the General Electric authorities were equally interested and went to considerable trouble to see that the students were given practical testing experience on the particular phase of engineering which was dealt with each week in the classrooms. The students were also anxious for the experiment, indeed enthusiastic to try it. To them it meant not only the possibility of better education but also financial help directly, and indirectly to those that decided to stay with the company at the end of the college course.

At the conclusion of the semester each student was backed to write his opinion about the experiment. The replies were very interesting. In every case the student appreciated that he had learned a great deal that he otherwise would have missed but believed decidedly that the time could have been better spent entirely at the college. The faculty reached the same conclusion, and felt that the result would have been very much the same if the periods had been longer.

As a consequence Union College has adopted the third alter-

native. Engineering students are given opportunity to get properly planned work at the General Electric Factories during vacations.

CULTURE.*

The little college town of Umphburg was ablaze with color.

It was autumn and the afternoon sun shone on fluttering pennants and bunting of varied hue that bedecked the palatial structure of the University of Umph.

Today was the day of all days—the day of the annual gridiron struggle between Umph and Shooch.

The million-dollar stadium gleamed in the autumn sun while thousands of students and alumni crowded through the gates to their seats at $20 the seat.

Inside the gridiron gladiators were listening to final instructions from their $500,000-a-year coaches.

On the curb outside the marble gateway was a line of ragged, wretched old men raising their piteous voices in their endeavor to eke out an existence by the sale of peanuts, pennants and chewing gum.

"Who," asked a stranger, "Who are those human derelicts? Who are those unfortunate creatures casting a blight on these noble surroundings? Who are those hopeless wrecks starving in the midst of plenty?"

"Them?" replied a freshman, "Them's our professors."

NECROLOGY.

F. L. EMORY.

Professor F. L. Emory was born in Dunenburg, Mass., April 9, 1867, the son of Edward Franklin and Mary Mildred Emory. He received his common school education there and attended college at Worcester, Mass., receiving a bachelor's degree in mechanical engineering in 1887. He was director of

* *The Pittsburgh Post*, February 24, 1920.

the mechanical and manual training department of Washington, D. C., high school 1887–89. He established and superintended the Trades School in the Massachusetts Reformatory 1890–91 at Concord Junction, Mass.

In the fall of 1891, he was selected by the late Dr. Eli Marsh Turner, then president of West Virginia University, to establish and take charge of the new department of mechanical engineering of West Virginia University organized that year under the provisions of the Morrill Act of congress. This he did most successfully, constructing the first mechanical hall on the site now occupied by the university heating plant. From 1892–95, he was engaged in establishing and directing the Industrial Training and Technical High School for the city of Indianapolis, Ind. He built and equipped this modern school to accommodate 1,200 pupils.

In the fall of 1895, he entered Cornell University to take postgraduate work and received a master of mechanical engineering degree from that institution in 1896. He then returned to West Virginia University to become professor of mechanics and applied mathematics, which position he held at the time of his death. In 1899, his alma mater, Worcester Polytechnic Institute, conferred on him the degree of master of engineering.

In addition to his teaching duties Professor Emory was for a number of years superintendent of grounds and buildings at the university and as such had charge of the construction of the armory, Mechanical Hall, Library, president's house and central heating plant of the university.

During his incumbency as a professor of the engineering faculty, Professor Emory made a most exhaustive study of the early history of the steam engine and steam engineering and at the time of his death, had perhaps the most complete collection of lantern slides on this subject in the United States. As chairman of the faculty committee in charge of the University Engineering Society, he accomplished most valuable work, for it was here that he devoted particular attention to stimulating

research by the advanced engineering students, and at the same time encouraged the development of forensic ability through papers and addresses which he had them prepare and read before the society.

With Dr. Frederick Truscott, of this city, he was co-author in the translation and publication of the "Philosophical Essay on Probabilities" by Laplace, in 1902, often referred to as the treatise on "Least Squares." More recently, he had completed a manuscript on "Strength of Materials" which was ready for the printer's hands. He had also written many papers for various scientific societies of which he was a member. He held membership in the American Society of Mechanical Engineers, and the Society for the Promotion of Engineering Education. He also served as a member of the board of school commissioners for Morgantown Independent school district, for a number of years. Professor Emory has been a member of the Society for the Promotion of Engineering Education since 1894.

LESLIE H. HARRIS.

Professor Leslie H. Harris died February 21, aged thirty-six years. He was born October 23, 1883, at Bradford, Pa. Together with his father and brother he spent his early life in the oil fields of the Middle West. In this work he was early impressed with the need of an engineering education in order to be better fitted for the industrial life of the day. He entered Purdue University in 1903, graduating with the degree of bachelor of science in electrical engineering in 1907.

While at Purdue, Professor Harris developed a keen interest in military science and tactics. This type of work was second only to his engineering pursuits. He rose to the rank of colonel in command of the Cadet organization. This military experience obtained at Purdue was responsible for his active participation in military matters during the late war. Upon completion of his work at Purdue, Professor Harris entered the employ of the Westinghouse Electric and Manufacturing

Company at East Pittsburgh in September. After working with this company for a short time, he received a call from the Western University of Pennsylvania to take up the work in the Department of Electrical Engineering. A year after entering the Western University, the entire institution was moved from its former location on the Northside to the Schenley Farms district where the School of Engineering occupies the new and modern engineering building made possible by public subscriptions.

This change gave Professor Harris an excellent opportunity to work out some new ideas in connection with the training of electrical engineering students. It is sufficient to say that many of his original ideas are not only still in use in this institution, but have been adopted by a number of other engineering schools. He was gradually advanced from instructor until in 1915 he was made professor and head of the Department of Electrical Engineering.

Another event occurred shortly before this time which was instrumental in shaping his future career. The Commonwealth of Pennsylvania decided to form a public service commission and ir order to properly standardize their engineering plans, the committee retained Professor Harris in the capacity of consulting engineer for the creation of their early rules and regulations. Professor Harris continued in the capacity of consulting engineer to the Commission throughout his connection with the University of Pittsburgh. Preceding the completion of the standardizing laboratory at Harrisburg, Professor Harris conducted all standardizing work for the State in the laboratories of the School of Engineering. His services continued to be more and more valuable to the Commission and, as a result, he resigned from the School of Engineering of the University of Pittsburgh, effective February 1, 1920, to take up continuous work as Division Engineer in the Public Service Commission in charge of the valuation work.

Military matters were one of Professor Harris's most interesting side issues and during the work of the Engineering

School in summer camp at Windber, he had charge of the military organization. This work was carried on during the summer of 1917, when America was beginning to take active participation in the world war. In this capacity, Professor Harris prepared a number of students for a successful military career during the next two years.

Being a member of the Reserve Officers' Training Corps at the time, he was called into service in August of that year. He went to Washington, but was later transferred to Camp Stuart at Newport News with the rank of major and the title of Port Utility Officer, having charge of the construction and embarkation camp located there.

Professor Harris was married on September 3, 1914, to Alma Kerr of the Northside. Mrs. Harris contracted pneumonia and died February 8, 1920. They leave one daughter, Alma Louise, aged four years.

Professor Harris was a member of the Eta Kappa Nu, Tau Beta Pi, and Delta Epsilon, being National Secretary of Eta Kappa Nu. He was also a member of the American Institution of Electrical Engineers, the Engineers Club of Harrisburg, and the Society for the Promotion of Engineering Education, having been assistant secretary of the latter from 1914 till he entered service. He was a member of the Society since 1912.

R. C. MACLAURIN.

Dr. Richard Cockburn Maclaurin, since 1908 president of Massachusetts Institute of Technology, died at his home in Cambridge, Mass., January 15. He succumbed to pneumonia in the prime of a remarkably constructive life devoted to higher education, being only fifty years old at the time of his death. That he had received the Cambridge University degrees of Sc.D. at the age of twenty-eight, LL.D. at thirty-four, and became president of Massachusetts Institute of Technology at thirty-eight is evidence of his versatility and brilliance. His

* *Engineering News Record*, Vol. 84, No. 4.

ability as an organizer, financier, and developer of educational institutions was no less remarkable than his attainments in science and law.

Richard Cockburn Maclaurin was born in Lindean, Scotland, in 1870. His early boyhood was spent in New Zealand, whence he returned to England to complete his preliminary education. In 1892 he entered the University of Cambridge, where he held a foundation scholarship in St. John's College. He took two degrees at Cambridge, B.A. and M.A., the thesis work for the latter being advanced mathematics. He received the Smith prize for excellence in mathematics, and upon graduation was elected Fellow of St. John's College.

Leaving Cambridge, Dr. Maclaurin next spent ten months in the United States and Canada (1896–97) studying and visiting educational institutions and spending much time at McGill (Toronto) and Leland Stanford universities. Returning to England he re-entered Cambridge, this time to study law, and was awarded the McMahon law studentship, the most highly valued of its kind in the university.

In 1898 Dr. Maclaurin was appointed professor of mathematics in the University of New Zealand, became a trustee of the university, and took an active part in the organization of technical education in that colony. He became dean of the faculty of law in the university in 1903 and continued in that capacity for the next four years. In 1898 Cambridge University honored him with the degree of doctor of science and again in 1904 with the degree of doctor of law.

He was invited to take the chair of mathematical physics at Columbia University, New York City, in 1907, and a year later was made head of the Department of Physics. Dr. Maclaurin was appointed president of Massachusetts Institute of Technology, November 23, 1908, succeeding Henry S. Pritchett, who had retired to become chairman of the Carnegie Foundation. At that time Massachusetts Institute of Technology had reached the limit of its facilities and still fell far short of fully carrying out the plans of its founders. Its buildings, equip-

ment and funds were only a fraction of its needs. Dr. Maclaurin undertook to make up the deficiencies.

First he unified the corporation and the faculty, and by his personality gained the confidence of the alumni and bound them as never before into a great force working for the benefit of their alma mater. One of the first fruits of his efforts was the gift of T. Coleman du Pont of half a million dollars toward the purchase of a new site for Technology at Cambridge. The corporation at the same time made up another quarter-million which completely paid for the land. Following this, with the aid of the alumni, he secured the passage of a Massachusetts act granting additional funds for the support of the school.

When the site question was settled it was necessary to procure enormous sums for the construction and maintenance of plant, and with the enthusiastic support of the alumni Dr. Maclaurin undertook to raise them. First came the gift of $2,500,000 from George Eastman, of Rochester, N. Y., which was closely followed by other gifts in sufficient measure to warrant the beginning of construction. Subsequent gifts from Mr. Eastman, made before 1919, amounted to $4,500,000, and finally, only a few months ago, was made his offer of $4,000,000 contingent upon the raising of an additional $8,000,000 for proper financing of the institute. At an alumni dinner in Boston, January 10, it was announced that the $8,000,000 had been made up, that Mr. Eastman had made good his $4,000,000 promise and that the Massachusetts Institute of Technology now has an additional endowment of $12,000,000.

Dr. Maclaurin must be directly credited with the creation of the organization and the spirit which made possible the surpassing facilities for technical education now possessed by the institution whose affairs he so ably guided.

President Maclaurin was a member of the Society for the Promotion of Engineering Education since 1909.

COLLEGE NOTES.

The University of Minnesota.—C. M. Jansky, Jr., was recently appointed an instructor in electrical engineering at the University of Minnesota, to specialize in radio and transients. Mr. Jansky is a graduate of the University of Wisconsin. He has had teaching experience in the Army Training Schools and in the University of Wisconsin, following several months of research work on military intelligence problems at the Western Electric laboratories in New York City, which were continued at Madison. He collaborated with his father, C. M. Jansky, in writing a text-book on "Radio Telegraphy." At the University of Minnesota, his work will include courses with the Signal Corps Unit of the R. O. T. C. and also with other advanced students.

The College of Engineering at the University of Minnesota, like similar institutions, is overwhelmed this year with an unprecedented increase in the number of students. The registration this year is about 1,150 students in engineering and architecture of whom 625 are freshmen.

The prospects are good for the construction of the new Electrical Engineering Building in the very near future.

University of Pennsylvania.—Mr. Chas. D. Fawcett, recently appointed assistant professor of electrical engineering at the University of Pennsylvania, graduated from the University of Colorado in 1911, following which he served as instructor at that institution for one year. For two years he worked in the testing department of the General Electric Company, and also in the research section of the transformer department. For several years he served as instructor in electrical engineering at the University of Pennsylvania, and in 1916 was appointed Assistant Secretary of the Illuminating Engineering Society with headquarters in New York.

Mr. H. R. West, recently appointed instructor in the Elec-

trical Engineering Department at the University of Pennsylvania, is a graduate of the University of South Dakota with the degree of A.B. in 1915 and that of M.A. in 1916.

From July to December, 1917, Mr. West was employed in the transmission engineering department of the Bell Telephone Company of Pennsylvania, and from December, 1917, to June, 1918, served in the operation and maintenance department of the Hog Island Shipyard. From June, 1918, to March, 1919, he was engaged on submarine detection work as an Ensign in the Navy, being detailed to the Naval Experimental Station at New London, Conn.

Mr. Walter J. Seeley, recently appointed to an instructorship in electrical engineering at the University of Pennsylvania, is a graduate of the Polytechnic Institute of Brooklyn, in the class of 1917. For two years following his graduation, Mr. Seeley was engaged in research and development work on submarine detection as an ensign in the Navy, at New London, Conn., and at Plymouth, England.

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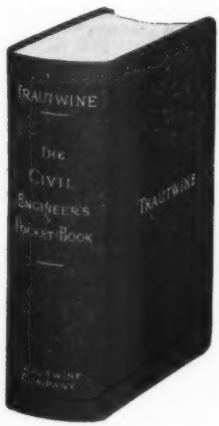

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